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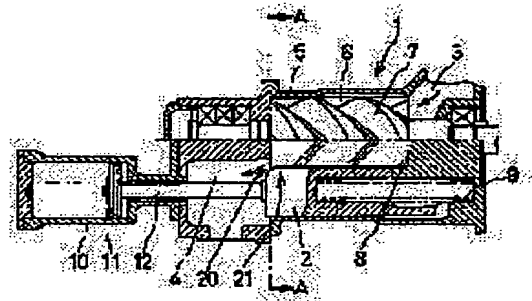
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(54) SCREW COMPRESSOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an excellent energy saving effect during compression operation, in a screw compressor wherein an internal volume ratio is regulated by a slide valve mechanism.

SOLUTION: In a screw compressor wherein an internal volume ratio is regulated by a slide valve 2 mechanism, an internal volume ratio V_{ia} determined by an axial port 20 is increased to a value higher than an internal volume ratio V_{ir} determined by a radial port 21. Further, on a condition that the internal volume ratio V_{ia} is $V_{ia}=4.0$, the internal volume ratio V_{ir} is $4.0 < V_{ir} \leq 6.0$.



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CLAIMS

[Claim(s)]

[Claim 1] The screw compressor characterized by coming to form the internal volume ratio V_{ia} decided by the axial port in the screw compressor which has the male rotor and female rotor of a pair which gear mutually, and the internal volume ratio accommodation by the slide valve system accomplishes to an axial port and a radial port more greatly than the internal volume ratio V_{ir} decided by the radial port.

[Claim 2] The screw compressor according to claim 1 whose internal volume ratio V_{ir} the internal volume ratio V_{ia} is $4.0 < V_{ir} \leq 6.0$ on condition that $V_{ia} = 4.0$.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to an oil-injection-type screw compressor equipped with the axial port and radial port which internal volume ratio accommodation accomplishes by the slide valve system about a screw compressor.

[0002]

[Description of the Prior Art] In a screw compressor, for example, a screw-type air compressor, the optimal port configuration and magnitude are determined about the configuration and size of a port of a delivery according to the value of a discharge pressure. Although it is breathed out in a radial direction and the axial direction when the air compressed by compression operation is breathed out from the port of a delivery in that case, as for the mode of the port of the delivery in the conventional screw-type air compressor, it is common to have a configuration of a port where a radial direction and the axial direction are breathed out by coincidence, and magnitude.

[0003] It is [to the pressure of which value air is theoretically compressed in this kind of screw-type air compressor, and] the optimal internal volume ratio V_i with few power losses. It is determined at the design time, and when a service condition is fixed, it is that volume ratio V_i . It should consider as the interior volume ratio V_{io} of the optimal doubled with conditions, and leads to a power loss in the magnitude of the port [V_{io} / this] shifted.

[0004] Since it is such, it will bring ** and a power loss that it is ideal to consider as the optimal internal volume ratio V_{io} doubled also with the radial direction and the axial direction at conditions, and it shifts from the internal volume ratio V_{io} also with the optimal either. In the present condition, it is "the interior volume ratio V_{ia} of an interior volume ratio V_{i} of radial port = axial port" from such semantics so that it may be set to V_{io} corresponding to conditions.

[0005]

[Problem(s) to be Solved by the Invention] by the way, the thing by which the energy-saving effectiveness

which expects is not demonstrated [become] with much trouble as a result of being in a configuration in which the port of a delivery is breathed out in a radial direction and the axial direction at coincidence, and the thing used as magnitude, and becoming the situation which will shift from the conditions of $V_{ir}=V_{ia}$ by operating a slide valve system supposing it adopts the slide valve system for making internal volume ratio accommodation perform, therefore a power loss's arising is [in question] -- .

[0006] When an internal volume ratio switches to unload operation from full-load operation in the high condition conventionally The amount of the compressed gas which gas is compressed in the part of a slide valve system, and is returned to inlet port increases. Therefore, the amelioration technique which is made to perform control switched to unload operation, and was made to lessen useless power loss from the point with the problem more than which power loss increases after operating a slide valve system to the interior volume ratio side of low For example, by being proposed by JP,05-033789,A, preparing time difference in opening initiation of a radial port, and opening initiation of an axial port, and on the other hand, carrying out opening to them gradually Although the amelioration technique which eased the rapid increment in regurgitation port opening area is proposed by JP,06-323269,A and these are the techniques of aiming at the dissolution of the trouble resulting from the change of an internal volume ratio based on actuation of a slide valve system The solution technical problem of this invention which is going to mention the fruit of much more energy-saving effectiveness is only the advanced technology of the contents which were widely different rather than it can set at the time of compression operation.

[0007] In the screw compressor of the structure which accomplishes this invention in view of such a trouble, and the internal volume ratio accommodation by the slide valve system constitutes to an axial port and a radial port By constituting so that the regular conditions between the internal volume ratios V_{ir} decided by the internal volume ratio V_{ia} decided by the axial port and the radial port may be given It reaches to carry out the knowledge of being able to aim at reduction of power consumption and the better energy-saving effectiveness being acquired based on the result of an experiment in a variety of examination list by this invention person etc. About the screw compressor with which it comes to be invented here, therefore the internal volume ratio accommodation by the slide valve system accomplishes the purpose of this invention to an axial port and a radial port, it is in what you are going to make plan the good energy-saving effectiveness rather than it can set at the time of compression operation.

[0008]

[Means for Solving the Problem] This invention is considered as the configuration described below in order to attain the above-mentioned purpose. That is, it is the screw compressor characterized by invention of claim 1 concerning this invention coming to form the internal volume ratio V_{ia} decided by the axial port in the screw compressor which has the male rotor and female rotor of a pair which gear mutually, and the internal volume ratio accommodation by the slide valve system accomplishes to an axial port and a radial port more greatly than the internal volume ratio V_{ir} decided by the radial port.

[0009] Moreover, about the screw compressor of invention of above-mentioned claim 1, the internal volume ratios V_{ia} are the conditions of $V_{ia}=4.0$, and invention of claim 2 concerning this invention is characterized by becoming as a configuration whose internal volume ratio V_{ir} is $4.0 < V_{ir} \leq 6.0$.

[0010]

[Embodiment of the Invention] Hereafter, the desirable operation gestalt of this invention is explained concretely, referring to an accompanying drawing. The screw compressor concerning the gestalt of operation of this invention is shown to drawing 1 by the sectional view. Moreover, in drawing 2, the expanded sectional view in alignment with view line A-A of drawing 1 is shown, and the enlarged drawing of the radial port 8 section in drawing 1 is further shown in drawing 3 at it.

[0011] In drawing 1, the oil-injection-type screw compressor 1 comes to have the slide valve 2 for capacity accommodation. This screw compressor 1 holds the screw rotor 7 of a sex pair which gets into gear mutually pivotable in the Rota room 6 in the casing 5 by which inlet port 3 was established in one side, and it established the delivery 4 in another side, and is formed in it. Moreover, the above-mentioned slide valve 2 is seen from a screw rotor 7, and it is fitted in the rotor shaft possible [sliding] in parallel so that the tooth-space section of a screw rotor 7 may be covered to the opposite side of inlet port 3 with the internal surface of the Rota room 6 which encloses the perimeter of a screw rotor 7. The intake side edge side of this slide valve 2 will be in contact with the stopper 8 in the condition of illustrating, it will see from a screw rotor 7, and the passage between the above-mentioned intake side edge sides and stoppers 8 which make this inlet port 3 open a part for the intake flank of the opposite side of inlet port 3 for free passage will have been in the closed condition, i.e., the full load operational status of 100% capacity. Furthermore, this slide valve 2

is always energized towards discharge side with the spring 9 infixed between this and the internal surface of the casing 5 by the side of intake.

[0012] On the other hand, the oil hydraulic cylinder 10 has protruded on the discharge side of casing 5, and one end face of the piston 11 is open for free passage to the delivery 4. Moreover, the piston rod 12 of an oil hydraulic cylinder 10 is combined with the above-mentioned slide valve 2. The space section of another side of this piston 11 can make the force of a direction of it being able to be open for free passage now possible [a change] suitably to the high-pressure section or depression, and going to an intake side to a slide valve 2 through a piston 11 and a piston rod 12 act, can strengthen that force, or can weaken it now.

[0013] And in order to make capacity small and to make it partial load operational status, while making the oil in the space of above-mentioned another side lead to the low-tension side, a slide valve 2 is moved to a discharge side according to the force with the discharge-pressure plus above-mentioned spring 9 which acts on above-mentioned one end face. Consequently, the passage between the above-mentioned intake side edge side of a slide valve 2 and a stopper 8 will open, and it will see from a screw rotor 7, and the amount of [of the opposite side of inlet port 3] intake flank is open for free passage to this inlet port 3, a part of gas once inhaled by the screw rotor 7 will come to return to inlet port 3, and it will be in partial load operational status.

[0014] Moreover, the port configuration which the regurgitation port which is opening to the delivery 4 of the Rota room 6 which has contained the screw rotor 7 consists of an axial port 20 which carried out opening to the Rota shaft orientations, and a radial port 21 which carried out opening in the direction of a path, and was seen from the shaft orientations of the axial port 20 is as the field which gave and showed the slash to drawing 3 .

[0015] In the above-mentioned operation gestalt concerning this invention, the configuration and magnitude of the axial port 20 and the radial port 21 are beforehand set up so that the internal volume ratio (an axial volume ratio is called hereafter) V_{ia} decided by the axial port 20 may become always larger than the internal volume ratio (a radial volume ratio is called hereafter) V_{ir} decided by the radial port 21.

[0016] In order to have become possible to reduce the power at the time of screw compressor operation, i.e., the input of the motor which drives this compressor, rather than the conventional thing by having set up conditions of "the axial volume ratio $V_{ia} >$ radial volume ratio V_{ir} " which are mentioned above and to clarify this point quantitatively, it is based on carrying out assignment of the concrete example of an experiment as follows, and explains.

[0017] The compressor used for the experiment is form:HM55A (air cooling, 55kW), airflow:9.0m³/min (at the time of 100% full load), power (input):61kW, and discharge-pressure:7 kgf/cm². It is a screw compressor with the slide valve 2 for capacity accommodation.

[0018] It sets to the above-mentioned screw compressor, and is the relation between the axial volume ratio V_{ia} and the radial volume ratio V_{ir} as follows 1. slide-valve ** (axial volume ratio $V_{ia}=4.0$, radial volume ratio $V_{ir}=4.0$, example corresponding to the conventional technique)

2. Slide-Valve ** (Axial Volume Ratio $V_{ia}=5.5$, Radial Volume Ratio $V_{ir}=4.0$, Example of this Invention Operation Gestalt)

3. Slide-Valve ** (Axial Volume Ratio $V_{ia}=6.0$, Radial Volume Ratio $V_{ir}=4.0$, Example of this Invention Operation Gestalt)

The result of having surveyed and measured the inverter power consumption at the time of adjusting the capacity control valve 6 and making ** % load operation performing about three sorts which were boiled and were set up, respectively is as being shown in the number value of % of the following table 1 again at the graph of drawing 4 R> 4, respectively.

[0019]

[Table 1]

スライバ①	風量 %	100.0	86.9	72.3	59.7	46.7	34.3
	モータ入力 %	100.0	91.8	83.9	77.4	71.3	67.2
スライバ②	風量 %	100.0	88.6	72.8	60.5	45.0	33.5
	モータ入力 %	103.4	91.3	79.5	71.9	63.5	58.4
スライバ③	風量 %	100.0	—	75.0	—	50.0	34.0
	モータ入力 %	105.0	—	78.0	—	62.0	54.0

[0020] With reference to "Table 1" and drawing 4 , reduction of power consumption has accomplished

compared with slide-valve * (sample corresponding to the conventional technique) at the time of load operation below about 90% load by slide-valve ** concerning the operation gestalt of this invention, and **. However, near full-load operation, the direction of slide-valve ** and ** serves as less than 5% of power consumption rise conversely. In addition, rather than slide-valve **, although the energy-saving effectiveness appears more, the slide-valve **. On theoretical count, even if it makes the axial volume ratio V_{ia} larger than 6.0 If can face the further power improvement only about 2 to 3%, it serves as an inclination which gains in the power at the time of full-load operation conversely, it cannot declare that the fruit of an energy-saving improvement goes up uniquely and the above result is summarized In the case of radial volume ratio $V_{ir}=4.0$, it is considered that the value of 4.0 excess and less than 6.0 range is suitable for the axial volume ratio V_{ia} .

[0021]

[Effect of the Invention] This invention is carried out with a gestalt which was explained above, and does so effectiveness which is indicated below. That is, by having considered the internal volume ratio V_{ia} decided by the axial port in the screw compressor which the internal volume ratio accommodation by the slide valve system accomplishes to an axial port and a radial port as the configuration which it comes to form more greatly than the internal volume ratio V_{ir} decided by the radial port according to this invention, it is possible to reduce the power consumption of a motor which drives a compressor as compared with the conventional screw compressor of the same kind which is $V_{ir}=V_{ia}$, and it is a **** thing about the better energy-saving effectiveness.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view of the screw compressor concerning the gestalt of operation of this invention.

[Drawing 2] It is an expanded sectional view in alignment with view line A-A of drawing 1.

[Drawing 3] It is the enlarged drawing of the radial port 8 section in drawing 1.

[Drawing 4] It is an airflow-power consumption characteristic ray Fig. in the screw compressor and the conventional screw compressor of the same kind concerning the gestalt of operation of this invention.

[Description of Notations]

- 1 -- Oil-injection-type screw compressor 2 -- Slide valve for capacity accommodation 3 -- Inlet port
4 -- Delivery 5 -- Casing 6 -- Rota room
7 -- Screw rotor 8 -- Stopper 9 -- Spring
10 -- Oil hydraulic cylinder 11 -- Piston 12 -- Piston rod
20 -- Axial port 21 -- Radial port

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